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INVENTOR(S): GARY A. WATKINS
CHRISTOPHER L. OESTERLING

TITLE: METHOD FOR AUTOMATICALLY REPLENISHING PRE-PAID CALLING UNITS WITHIN A TELEMATIC UNIT

ATTORNEYS: ANTHONY LUKE SIMON, ESQ.
GENERAL MOTORS CORPORATION
LEGAL STAFF
MAIL CODE: 482-C23-B21
300 RENAISSANCE CENTER
P.O. BOX 300
DETROIT, MICHIGAN 48265-300

METHOD FOR AUTOMATICALLY REPLENISHING PRE-PAID CALLING UNITS WITHIN A TELEMATIC UNIT

FIELD OF THE INVENTION

In general, the invention relates to mobile application services in telematics units. More specifically, the invention relates to a method for automatically replenishing calling units within a mobile communication unit.

BACKGROUND OF THE INVENTION

A mobile application service provider provides information and services to the vehicles of subscribers from a data center through a vehicle installed wireless telecommunication apparatus. Examples of types of services provided are emergency response assistance, roadside service assistance, location-based services such as turn-by-turn directions, prepaid personal calling, phone number directory lookup assistance, and points of interest lookup. These services may be offered on pre-paid or non-prepaid arrangements.

One way of offering prepaid personal calling is by offering packages of pre-paid usage. Usage for example, can be measured in units, in terms of the number of minutes of operator assistance or amount of data transfer. When the pre-paid units are completely consumed, they must be replenished for the service to continue. This will require the subscriber to contact the service provider to purchase more units of service. Although service replenishment may be performed using the vehicle installed wireless telecommunication apparatus to connect to the data center, it requires the subscriber to interact with an automated voice system or a service representative to purchase the desired pre-paid service package.

Thus, there is a significant need for a method and system for automatically replenishing mobile application services in a vehicle so that the subscriber services remain uninterrupted.

SUMMARY OF THE INVENTION

One embodiment of the invention provides a method including the steps of operating the telematics unit to automatically report an occurrence of a trigger event to the data center and operating the data center to communicate a replenishment package to the telematics unit subsequent to the occurrence of the trigger event, wherein the replenishment package includes a first set of calling units. The method further includes
operating the telematics unit to automatically replenish itself with the first set of calling units in response to a reception of the replenishment package.

Another aspect of the invention provides a system including a telematics unit operable to automatically report an occurrence of a trigger event to said data center; and a data center operable to communicate a replenishment package to said telematics unit subsequent to the occurrence of the trigger event, wherein the replenishment package includes a first set of calling units, wherein said telematics unit is further operable to automatically replenish itself with the first set of calling units in response to a reception of the replenishment package.

Yet another aspect of the invention describes a telematics unit including means for automatically reporting and communicating an occurrence of a trigger event to a data center; and means for automatically replenishing itself with a first set of calling units in response to a reception of a replenishment package from the data center, wherein the reception of the replenishment package from the data center corresponds to the communicated occurrence of the trigger event.

The foregoing forms and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates one embodiment of a system for communicating from a telematics unit to a data center in accordance with the present invention;

FIG. 2 illustrates a flowchart representative of one embodiment in accordance with the present invention of a method for automatically replenishing pre-paid calling units within a telematics unit at the end of a billing cycle; and

FIG. 3 illustrates a flowchart representative of one embodiment in accordance with the present invention of a method for automatically replenishing pre-paid calling units within a telematics unit upon a complete consumption of the calling units.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

FIG.1 is an illustrative operating environment for a vehicle in an embodiment of the present invention. FIG. 1 shows a vehicle communication system **100**. Vehicle communication system **100** includes at least one vehicle **110** including vehicle communication bus **112** and telematics unit **120**, one or more wireless carrier systems **140**, one or more communication networks **142**, one or more land networks **144**, one or more client, personal or user computers **150**, one or more web-hosting portals **160**, and one or more call centers **170**. In one embodiment, vehicle **110** is implemented as a mobile vehicle equipped with suitable hardware and software for transmitting and receiving voice and data communications.

In one embodiment, telematics unit **120** is a vehicle communications unit that includes a digital signal processor (DSP) **122** connected to a wireless modem **124**, a global positioning system (GPS) unit **126**, an in-vehicle memory **128**, such as, for example, a non-volatile flash memory, a microphone **130**, one or more speakers **132**, an embedded or in-vehicle mobile phone **134**, and a wireless access point node **136**. DSP **122** is also referred to as a micro-controller, controller, ASIC, host processor, or vehicle communications processor. GPS unit **126** provides longitude and latitude coordinates of the vehicle, as well as a time stamp. In-vehicle mobile telephone system **134** is a cellular-type phone, such as, for example an analog, digital, dual-mode, dual-band, multi-mode or multi-band cellular phone. In another example, the mobile telephone system is an analog mobile telephone system operating over a prescribed band nominally at 800 MHz. In another example, the mobile telephone system is a digital mobile telephone system operating over a prescribed band nominally at 800 MHz, 900 MHz, 1900 MHz, or any suitable band capable of carrying digital cellular communications.

In one example, modem **124** includes a Prepaid Personal Calling ("PPC") loading module **115** capable of communication with at least one call center **170**. In one embodiment of the invention, PPC loading module **115** is an embedded component of the modem **124** capable of providing a wireless communication link between the telematics unit **120** and call center **170**. In another embodiment, the PPC loading module **115** is external to the modem **124**, and in communication with the telematics unit **120**. PPC loading module **115** is configured to perform at least the methods disclosed herein. In one embodiment, PPC loading module **115** is pre-programmed with an initial, predetermined number of PPC units. In a second embodiment, PPC loading module **115** secures an initial number of PPC units from call center **170**. A replenishment package is a package of PPC units. In one embodiment, a replenishment package is a predetermined number of units. For example, a replenishment

package may increase the number of PPC units by 150 units. In another embodiment, replenishment package increases an existing number of units to a predetermined number of units. In another example, a replenishment package may increase the number of PPC units to 150 units.

DSP **122** executes various computer programs and communication control and protocol algorithms that control communication, programming and operational modes of electronic and mechanical systems within vehicle **110**. In one embodiment, DSP **122** is an embedded system controller. In another embodiment, DSP **122** controls communications between telematics unit **120**, wireless carrier system **140**, and call center **170**. In another embodiment, DSP **122** controls communications between the wireless access point node **134** and nodes of a mobile ad hoc network. In one embodiment, a speech-recognition application is installed in DSP **122** to translate human voice input through microphone **130** into digital signals. DSP **122** generates and accepts digital signals transmitted between telematics unit **120** and a vehicle communication bus **112** that is connected to various electronic modules in the vehicle **110**. In one embodiment, the digital signals activate a programming mode and operation modes, as well as provide for data transfers. In another embodiment, a vehicle data upload (VDU) utility program facilitates the transfer of instructions and data requests to vehicle **110.**

Vehicle **110**, via a vehicle communication bus **112**, sends signals to various units of equipment and systems within the vehicle **110** to perform various functions such as monitoring the operational state of vehicle systems, collecting and storing data from the vehicle systems, providing instructions, data and programs to various vehicle systems and calling from telematics unit **120**. In facilitating interactions among the various communication and electronic modules, vehicle communication bus **112** utilizes bus interfaces such as controller-area network (CAN), J1850, International Organization for Standardization (ISO) Standard 9141, ISO Standard 11898 for high-speed applications, and ISO Standard 11519 for lower speed applications.

Vehicle **110**, via telematics unit **120**, sends and receives radio transmissions from wireless carrier system **140**. Wireless carrier system **140** is implemented as any suitable system for transmitting a signal from mobile vehicle **110** to communication network **142**. Wireless carrier system **140** incorporates any type of telecommunications in which electromagnetic waves carry signal over part of or the entire communication path. In one embodiment, wireless carrier system **140** transmits analog audio, digital audio (including, but not limited to, CDMA, TDMA, FDMA, GSM) and/or video signals. In an example, wireless carrier system **140** transmits analog audio and/or video signals such as those sent from AM and FM radio stations and transmitters, or digital audio signals in the S band (approved for use in the U.S.) and L band (used in Europe and Canada). In one embodiment, wireless carrier system **140** is a satellite broadcast system broadcasting over a spectrum in the "S" band (2.3 GHz) that has been allocated by the U.S. Federal Communications Commission (FCC) for nationwide broadcasting of satellite-based Digital Audio Radio Service (DARS).

Communication network **142** includes services from one or more mobile telephone switching offices and wireless networks. Communication network **142** connects wireless carrier system **140** to land network **144**. Communication network **142** is implemented as any suitable system or collection of systems for connecting wireless carrier system **140** to mobile vehicle **110** and land network **144**. In one example, wireless carrier system **140** includes a short message service, modeled after established protocols such as IS-637 SMS standards, IS-136 air interface standards for SMS, and GSM 03.40 and 09.02 standards. Similar to paging, an SMS communication could be broadcast to a number of regional recipients. In another example, the carrier system **140** uses services in accordance with other standards, such as, for example, IEEE 802.11 compliant wireless systems and Bluetooth compliant wireless systems.

Land network **144** is, in one embodiment, a public-switched telephone network (PSTN). In one embodiment, land network **144** is implemented as an Internet protocol (IP) network. In other embodiments, land network **144** is implemented as a wired network, an optical network, a fiber network, another wireless network, or any combination thereof. Land network **144** is connected to one or more landline telephones. Land network **144** connects communication network **142** to user computer **150**, web-hosting portal **160**, and call center **170**. Communication network **142** and land network **144** connects wireless carrier system **140** to web-hosting portal **160** and call center **170**.

Client, personal or user computer **150** includes a computer usable medium to execute Internet browser and Internet-access computer programs for sending and receiving data over land network **144** and optionally, wired or wireless communication networks **142** to web-hosting portal **160** and vehicle **110**. Personal or user computer **150** sends data requests to web-hosting portal through a web-page interface using communication standards such as hypertext transport protocol (HTTP), and transport-control protocol Internet protocol (TCP/IP). In one embodiment, the data includes directives to change certain programming and operational modes of electronic and mechanical systems within vehicle **110**. In another embodiment, the data includes directives to send certain data such as operational modes of electronic and mechanical systems within vehicle **110**. In operation, a user, such as, for example, a vehicle designer or manufacturing engineer, utilizes user computer **150** to access real-time data from vehicle **110** that is cached or stored in web-hosting portal **160**. Data from client-side software is transmitted to server-side software of web-hosting portal **160**. In one embodiment, data is stored at web-hosting portal **160**. In another embodiment, client computer **150** includes a database (not shown) for storing received data. In yet another embodiment, a private Local Area Network (LAN) is implemented for client computer **150** and Web hosting portal **160**, such that web hosting portal is operated as a Virtual Private Network (VPN).

Web-hosting portal **160** includes one or more data modems **162**, one or more web servers **164**, one or more databases **166**, and a network **168**. In one embodiment, web-hosting portal **160** is connected directly by wire to call center **170**, or connected by phone lines to land network **144**, which is connected to call center **170**. In another embodiment, web-hosting portal **160** is connected to call center **170** without a direct wire connection, but with a connection allowing communication between the call center **170** and the web-hosting portal **160**. Web-hosting portal **160** is connected to land network **144** by one or more data modems **162**. Land network **144** sends digital data to and from modem **162**; data that is subsequently transferred to web server **164**. In one implementation, modem **162** resides inside web server **164**. Land network **144** transmits data communications between web-hosting portal **160** and call center **170**.

Web server **164** receives various data requests or instructions from user computer **150** via land network **144**. In alternative embodiments, user computer **150** includes a wireless modem to send data to web-hosting portal **160** through a wireless communication network **142** and a land network **144**. Data is received by modem **162** and sent to one or more web servers **164**. In one embodiment, web server **164** is implemented as any suitable hardware and software capable of providing web services to transmit and receive data from user computer **150** to telematics unit **120** in vehicle **110**. Web server **164** sends to or receives data transmissions from one or more databases **166** via network **168**. Web server **164** includes computer applications and files for managing data.

In one embodiment, one or more web servers **164** are networked via network 168 to distribute data among its network components such as database **166**. In an example, database **166** is a part of or a separate computer from web server **164**. In one embodiment, web-server **164** sends data transmissions with data to call center **170** via modem **162**, and through land network **144**.

Call center **170** is a location where many calls are received and serviced at the same time, or where many calls are sent at the same time. In one embodiment, the call center is a telematics call center, facilitating communications to and from telematics unit **120** in vehicle **110**. In an example, the call center is a voice call center, providing verbal communications between an advisor in the call center and a subscriber in a mobile vehicle. In another example, the call center contains each of these functions. In other embodiments, call center **170** and web-hosting portal **160** are located in the same or different facilities.

Call center **170** contains one or more voice and data switches **172**, one or more communication services managers **174**, one or more communication services databases **176**, one or more communication services advisors **178**, and one or more networks **180**.

Switch **172** of call center **170** connects to land network **144**. Switch **172** transmits voice or data transmissions from call center **170**, and receives voice or data transmissions from telematics unit **120** in mobile vehicle **110** through wireless carrier system **140** and/or wireless access point node **136**, communication network **142**, and land network **144**. Switch **172** receives data transmissions from, and sends data transmissions to, one or more web-hosting portals **160**. Switch **172** receives data transmissions from, or sends data transmissions to, one or more communication services managers **174** via one or more networks **180**.

Communication services manager **174** is any suitable hardware and software capable of providing communication services to telematics unit **120** in mobile vehicle **110**. Communication services manager **174** sends to or receives data transmissions from one or more communication services databases **176** via networks **180**. Communication services manager **174** sends to or receives data transmissions from one or more communication services advisors **178** via networks **180**. Communication services database **176** sends to or receives data transmissions from communication services advisor **178** via networks **180**.

Communication services advisor **178** receives from or sends to switch **172** voice or data transmissions.

Communication services manager **174** facilitates one or more services, such as, but not limited to, enrollment services, navigation assistance, directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance and vehicle data management services. Communication services manager **174** receives service requests for data from a user via user computer **150**, web-hosting portal **160**, and land network **144**. Communication services manager **174** transmits and receives operational status, instructions and other types of vehicle data to telematics unit **120** in vehicle **110** through wireless carrier system **140**, communication network **142**, land network **144**, wireless access point node **136,** voice and data switch **172**, and networks **180**. Communication services manager **174** stores or retrieves vehicle data and information from communication services database **176**. Communication services manager **174** provides requested information to communication services advisor **178**.

In one embodiment, communication services advisor **178** is a real advisor. In another embodiment, communication services advisor **178** is implemented as a virtual advisor. In an example, a real advisor is a human being at service provider service center in verbal communication with service subscriber in mobile vehicle **110** via telematics unit **120**. In another example, a virtual advisor is implemented as a synthesized voice interface responding to requests from telematics unit **120** in mobile vehicle **110**.

Communication services advisor **178** provides services to telematics unit **120** in mobile vehicle **110**. Services provided by communication services advisor **178** include enrollment services, navigation assistance, real-time traffic advisories, directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance. Communication services advisor **178**

communicates with telematics unit **120** in mobile vehicle **110** through wireless carrier system **140**, communication network **142**, and land network **144** using voice transmissions, or through communication services manager **174** and switch **172** using data transmissions. Switch **172** selects between voice transmissions and data transmissions.

Vehicle **110** initiates service requests to call center **170** by sending a voice or digital-signal command to telematics unit **120** which in turn, sends an instructional signal or a voice call through wireless modem **124**, wireless carrier system **140**, communication network **142**, and land network **144** to call center **170**. In another embodiment, the service request is for a vehicle data upload (VDU) that initiates a data transfer between vehicle **110** and service center **170** or web hosting portal **160**. In another embodiment, the mobile vehicle **110** receives a request from call center **170** to send various vehicle data from mobile vehicle **110** through telematics unit **120** through wireless modem **124**, wireless access point node **136**, wireless carrier system **140**, communication network **142**, and land network **144** to call center **170**.

FIG. 2 illustrates a flowchart **200** and a flowchart **300** that are executed by PPC loading module **115** and data center **170**, respectively, in implementing an automated monthly PPC unit replenishment method of the present invention. While in practice telematics unit **120** can have any PPC billing cycle, flowcharts **200** and **300** will be described herein as if telematics unit **120** has a PPC billing cycle that occurs the 1st of every month.

In operation, during a stage **S202** of flowchart **200**, PPC loading module **115** monitors a calendar to thereby detect an occurrence of an end of a PPC billing cycle for telematics unit **120**. PPC loading module 115 proceeds from stage **S202** to a stage **S204** upon detecting an end of the current billing cycle for telematics unit **120** (e.g., January 1st). During stage **S204**, telematics unit **120** conventionally connects with data center **170** to communicate the end of the PPC billing cycle as a PPC trigger event to data center **170**. A PPC trigger event

indicates one of various events (e.g., end-of-billing-cycle and interim unit replenishing). Thus, in response thereto, data center **170** determines during a stage **S302** of flowchart **300** if the PPC trigger event indicates an event of a billing cycle for telematics unit **120**, and if so, call center **170** automatically proceeds to a stage **S304** to identify and communicate an appropriate PPC unit package to PPC loading module **115**. In one embodiment of stage **S304**, call center **170** identifies the PPC unit package from a customer account associated with telematics unit **120** and automatically uploads the PPC unit package to PPC loading module **115**. For example, the automatically uploaded PPC unit package may be a first replenishment package after the first detection of a trigger event, or the PPC unit package may be a second replenishment package after the second detection of a trigger event. Subsequent packages (third, fourth fifth, etc.) are also included herein. The replenishment packages (first, second, etc.) may be either a fixed number of PPC units, e.g. 150, or the replenishment packages may be a variable number of PPC units sufficient to increase the existing PPC units to a certain number, e.g. 150. Thus, for example, if a telematics unit currently has 14 PPC units, the first (second, etc.) replenishment package may add 150 PPC units (making the total 164 units in the telematics unit), or the replenishment package may increase the existing units to 150 by adding 136 PPC units.

Upon receipt of the PPC unit package by PPC loading module **115**, telematics unit **120** replenishes its PPC units and PPC loading module **115** communicates the replenishment of the PPC units to call center **170** during a stage **S206**. During a stage **S306**, call center **170** acknowledges the replenishment of the PPC units by telematics unit **120** and communicates an PPC trigger reset to PPC loading module **115**, which resets the PPC trigger to the end of the next billing cycle (e.g., February 1st) during a stage **S208**. PPC loading module **115** thereafter returns to stage **S202** to monitor the calendar, while call center **170** terminates flowchart **300** until call center **170** receives another PPC trigger event from PPC loading module **115**.

FIG. 3 illustrates a flowchart **400** and a flowchart **500** that are executed by PPC loading module **115** and call center **170**, respectively, in implementing an automated interim PPC unit replenishment method of the present invention. The purpose of this method is to replenish the PPC units of telematics unit **120**, if necessary, during a PPC billing cycle.

In operation, during a stage **S402** of flowchart **400**, PPC loading module **115** monitors a consumption of PPC units by telematics unit **120** to thereby detect an occurrence of a depletion of the PPC units of telematics unit **120**. PPC loading module **115** proceeds from stage **S402** to a stage **S404** upon a detection of a depletion of the PPC units. During stage **S404**, PPC loading module **115** conventionally connects to data center **115** to report and communicate the depletion of the PPC units as a PPC trigger event to call center **170**. In response thereto, call center **170** determines during a stage **S502** of flowchart **500** if the PPC trigger event indicates a depletion of the PPC units for telematics unit **120**, and if so, automatically proceeds to a stage **S504** to identify and deliver one or more PPC unit packages to telematics unit **120**. In selecting which PPC unit package(s) to offer, call center **170** considers (1) the size of the depleted PPC unit package, (2) the date the depleted PPC unit package was first utilized by telematics unit 120, and (3) the current date. In one embodiment, call center 170 calculates a baseline PPC unit package as a function of a product of (1) an average of the minutes per day used by telematics unit **120** during a consumption of the depleted PPC unit package, and (2) the number of days remaining before the end of the current billing cycle. In selecting the PPC unit packages to offer to telematics unit **120**, call center **170** uses (1) the baseline number of PPC units, and/or (2) rounds up the baseline number of PPC units by "x" units (e.g., 10 or 25).

Upon receipt of the offered PPC unit package(s) during a stage **S406**, a user of PPC loading module **115** can either (1) select an offered PPC unit package or (2) request a different PPC unit package that has more or less PPC units than the current offered PPC unit package(s). PPC loading module **115** eventually communicates a final selection of an offered PPC unit package to call center **170**, which communicates the selected PPC unit package to PPC loading module **115** during a stage **S506**. In one embodiment of stage **S304**, call center **170** automatically uploads the selected PPC unit package to PPC loading module **115**.

Upon receipt of the selected PPC unit package, telematics unit **120** replenishes its PPC units and PPC loading module **115** communicates the replenishment of the PPC units to call center **170** during a stage **S408**. PPC loading module **115** thereafter returns to stage **S402** to monitor a consumption of the PPC units by telematics unit **120**, while call center **170** terminates flowchart **500** until such time call center **170** receives another PPC trigger event from PPC loading module **115**.

From the preceding descriptions herein of flowcharts **200-300** as illustrated in **FIGS. 2** and **3**, those having ordinary skill in the art will appreciate various advantages of the present invention, such as, for example, an elimination of a need for a customer to have to call a data center or the like to purchase more PPC units at the end of a billing cycle or upon a depletion of PPC units during a billing cycle. Furthermore, those having ordinary skill in the art will appreciate that, in practice, the automated monthly PPC replenishment method and the automated interim PPC replenishment method of the present invention can be individually executed as described and illustrated herein, or merged into single PPC replenishment method.

While the embodiments of the invention disclosed herein are presently considered to be preferred, various changes and modifications can be made without departing from the spirit and scope of the invention. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein.